PROC. ENTOMOL. SOC. WASH.
92(3), 1990, pp. 548–551

SCALE-LIKE STRUCTURES ON THE TIBIA OF THE PARASITIC WASPS, *TRICHOGRAMMA* SPP. (HYMENOPTERA: TRICHOGRAMMATIDAE)

AKEY C. F. HUNG

Beneficial Insects Laboratory, USDA-ARS, Beltsville, Maryland 20705.

Abstract.—Nine scale-like structures were found at the distal end of the hind tibia in both sexes of *Trichogramma.* No pore can be detected in these structures and they are so thin that they appear transparent. Behavioral observations indicate that they are probably used as brush to transfer a secretion from the abdomen to the wings to keep them from drying and thus increases the aerodynamic function of the wings, or it might be that some unknown behavioral semiochemical is transferred to the wing.

Key Words: SEM, morphology, behavior, aerodynamic, semiochemical

A scale-like structure in the parasitic wasps, *Trichogramma* spp., was first reported by Hung at the First International Symposium on *Trichogramma* and Other Egg Parasites in 1981 (Hung 1982). This unique structure was subsequently found in other *Trichogramma* by Cals and Cals-Usciati (1987) and Schmidt and Smith (1987). However, none of these papers gave a detailed description. Since this structure has never been observed in any other group of insects, further description and discussion are given here.

MATERIALS AND METHODS

Seven species of *Trichogramma* were used in this study, namely *T. exiguum* Pinto and Platner, *T. maltbyi* Nagaraja and Nagarkatti, *T. minutum* Riley, *T. nubilale* Ertle and Davis, *T. parkeri* Nagakatti, *T. pretiosum* Riley, and *T. stampae* Vincent. *Heliothis virescens* (F.) eggs killed by exposure to ca. 30 krad of gamma radiation were used as the host in rearing the cultures. All cultures were maintained individually in 10-dram plastic vials at 27°C, 70–80% relative humidity.

Live wasps were fixed in chilled 3% glutaraldehyde for 3 h at room temperature and dehydrated through 100% ethanol. They were then critical point dried, mounted on stubs with silver paint and coated with gold/palladium alloy. The specimens were studied with both Hitachi S-430 and Hitachi HHS-2R scanning electron microscopes at an accelerating voltage of 15 and 20 kV. Specimens freshly killed with CO_2 can also be mounted directly on stubs with TV tube coat and studied at 15 kV without gold/palladium coating for up to one hour before they collapse. Behavioral observation was carried out under WILD M5D stereomicroscope.

RESULTS AND DISCUSSION

Nine scale-like structures were found in both sexes of all seven species studied. They are located on the inner surface at the distal end of hind tibia (Fig. 1). Six of them form a half-ring around the tarsal socket (Fig. 2). The 7th scale is located about 5 micra above the ring, in line with the tibial spur (sp). The remaining two are on the same line between scales 6 and 7. Scale 9 is about 15 micra

above the ring with 8 about half-way in between. Each scale is socketed. Their dimensions are 10–19 micra in length, 2.5–7.6 micra in width and 0.16–0.5 micra in thickness, with #1 the largest and #9 the smallest in size. Each scale is corrugated on both sides (Fig. 3) and keeled underneath (Fig. 2). No pore can be detected even at 20K magnification. Each scale is so thin that it can be seen through when two scales are partially overlapped (Fig. 4). The thinness of this structure has caused problems in studying it under SEM, because the tip can readily curve up under the electron beam even at 15 kV with metal-coated specimens.

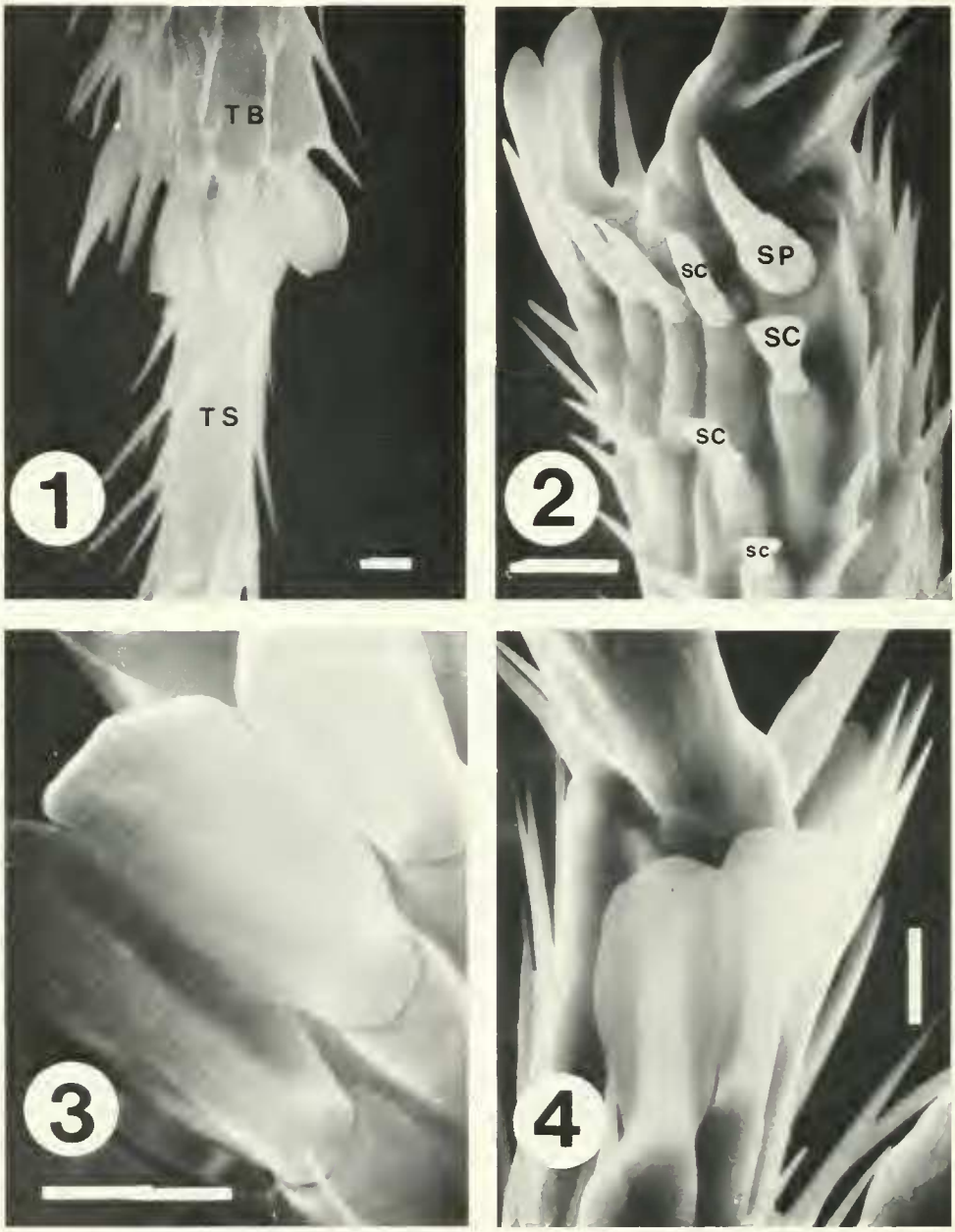
Rosen and DeBach (1976) reported the presence of strigil on fore leg and saltatorial mid-tibial spur in *Aphytis chilensis* Howard. However, they did not mention any scale-like structure. Despite the size of these scales in relation to the tarsal segment (see Fig. 1), they cannot be clearly detected with the phase contrast microscope in slide preparations even when mounted in glycerine or distilled water. Under both compound and stereo microscopes, only what appear to be setae at the apex of the tibia can be seen to have an arrangement very similar to that of these scale-like structures. Under stereomicroscope, if the position of the leg or the light source is manipulated at various angles, a thin membrane can be detected around these "setae." Therefore, it is apparent that these structures are so thin and transparent that they cannot be discerned under light microscopes and only the middle ridges can be seen which have the appearance of setae.

Cals and Cals-Usciati (1987) briefly described these structures in *T. maidis* Pintureau and Voegele. They also reported the occurrence of "similar" structures on the pretarsus which they called "scraping setae." However, these "linear serie (sic) of scraping setae" are not "petal-like" as originally reported by Hung (1982). Schmidt and Smith (1987) also found the same structure in *T. minutum* in their SEM study. According to them, there are eight flattened and grooved modified hairs that form a wing comb at the distal rim of the metatibia; the outer surface of each hair is marked with four to five sculpted ridges and the inner surface is smooth (Schmidt and Smith 1987). However, as pointed out by Hung (1982), there are nine such structures (see Fig. 2). Furthermore, each scale is corrugated on both sides with more than 10 ridges and keeled underneath (Figs. 2, 3). Whether these differences reflect variations not observed previously cannot be confirmed at this stage.

The lack of any pores rules out the possibility that they are chemoreceptors. It is possible that the pores may be very small and not visible at the resolution and magnifications used in this study. However, the use of higher magnification will certainly be very difficult, if not impossible, because these structures can readily be deformed under the electron beam. They could be mechanoreceptors which are stimulated when the legs touch the abdomen or ovipositor. However, it is hard to understand why such mechanoreceptors need to be shaped like scales.

Many species of insects communicate with each other by tapping their antenna or feet against the bodies of other insects. Radiation from thin layers of molecules coated in insect bodies can be modulated by this tapping (Callahan 1977). The thinness and corrugations of these scale-like structures on the hind leg might be used for the impedance match for some incoming far IR radiation, possibly from some host oscillating molecule (P. S. Callahan, per. comm.).

The function of this structure can only be speculated, based on my observation of the behavior of this wasp. Both male and female *Trichogramma* frequently rub the legs against the abdomen and the wings. It is this particular part of the leg where the scales are located that is used in this abdominal stroking and wing brushing. Although they also rub the legs against each other, only the tarsal segments are involved. It is, therefore,



Figs. 1–4. The scale-like structure in *Trichogramma* spp. 1. *T. exiguum* female, hind tibia (TB) and tarsus (TS) with the scales. 2. *T. stampae* female, distal end of hind tibia (pointing upward) showing nine scales (SC) and the spur (SP). 3. *T. maltbyi* female, the corrugated surface of the scale. 4. *T. nubilale* female, two overlapped scales showing the thin membrane. Bars = 5 microns.

conceivable that these scale-like structures are used to transfer some kind of secretion from the abdomen to the wings. This is supported by the oily appearance of the wings. The brushing of wings with abdominal secretion might be used to keep the wings from drying and thus increase the aerodynamic function of the wings, or it might be that some unknown behavioral semiochemical is transferred to the wing.

Acknowledgments

I am grateful to Norita Chaney for her assistance with SEM work, to David L. Vincent for maintaining the *Trichogramma* cultures, and to Philip S. Callahan, Ronald S. Petralia and John D. Pinto for reviewing the manuscript.

Literature Cited

Callahan, P. S. 1977. Tapping modulation of the far infrared (17-μm region) emission from the cabbage looper moth pheromone (sex scent). Appl. Optics 16: 3098–3102.

Cals, P. and J. Cals-Usciati. 1987. Repartition metamerique des structures cuticularies d'un insecte evolue: *Trichogramma maidis* (Hymenoptera: Chalcidoidea). C. R. Acad. Sci. Paris (Serie 3) 305: 129–133.

Hung, A. C. F. 1982. Petal-like structure in *Trichogramma* (Abstract). Les Colloques de l'INRA 9: 11.

Rosen, D. and P. DeBach. 1976. Biosystematic studies on the species of *Aphytis* (Hymenoptera: Aphelinidae). Mushi 49: 1–17.

Schmidt, J. M. and J. J. B. Smith. 1987. The external sensory morphology of the legs and hairplate system of female *Trichogramma minutum* Riley (Hymenoptera: Trichogrammatidae). Proc. Roy. Soc. Lond. (B) 232: 323–366.